

REMARKS**I. STATUS OF THE CLAIMS**

Claims 54, 55, 61 – 65, 69, 76, 77, 79, 81, 82, 85, 91 – 96, 98 – 99 and 130 -132 are presented. Support for the amendments to the claims, and for the new claims 130 -132, is found throughout the present specification and throughout the claims as originally filed, and in application serial number 10/695,212, which was filed on the same day as the present application and which is incorporated in the present application by reference. More specifically, the amendments to claim 54 are supported as follows:

AMENDMENT	SUPPORT
"for use in an air conditioning system"	page 10, lines 26 – 29
"a fluorinated propene having no substantial acute toxicity"	original claim 66 and page 6, lines 30 - 31
"poly alkylene glycol lubricant"	page 9, lines 5 – 8
"in the form of a homopolymer or co-polymer consisting of 2 or more oxypropylene groups and having a viscosity of from about 10 to about 200 centistokes at about 37°C"	from Application 10/695,212, page 12, lines 7 – 10 and page 13, lines 16 – 20

II. DOUBLE PATENTING REJECTIONS

Claims 54, 55, 64, and 76, as previously presented, have been rejected on the ground of non-statutory obviousness-type double patenting as allegedly being unpatentable over claim 4 of US 7,279,451.

Applicants will consider filing a terminal disclaimer directed to the abovementioned patent if the claimed subject matter is otherwise allowable. Such a terminal disclaimer will render this obviousness-type double patenting rejection moot.

III. OBVIOUSNESS REJECTIONS

A. Rejections over Smits, Aoyama, and optionally Nimitz.

The Examiner had rejected several of the previously pending claims under 35 U.S.C. § 103(a) as allegedly being unpatentable over US 4,945,119 (Smits) in view of US 5,679,875 (Aoyama), and/or in further view of US 5,674,451 (Nimitz). Applicants respectfully submit that a prima facie case of obviousness can not be properly made on the basis of any combination of these references, for at least the reasons stated below in Section III.C. Moreover, even if a rejection on the basis of prima facie obviousness were proper, applicants respectfully submit that such a rejection is rebutted by the evidence submitted herewith, as explained in detail in Section III.D. below.

B. Rejections over Daikin

The Examiner had rejected several of the previously pending claims under 35 U.S.C. § 103(a) as allegedly being unpatentable over JP 04110388 (Daikin). Applicants once again do not concede that a prima facie case of obviousness can be properly based on Daikin. Nevertheless, even if a rejection on the basis of prima facie obviousness over Daikin were proper, applicants respectfully

submit that such a rejection is rebutted by the evidence submitted herewith, as explained in detail in Section IIII.D. below.

C. Prima Facie Obviousness Has Not Been Established

A prima facie case of obviousness of the claims, as amended, can not be made based on the prior art cited by the Examiner.

The pending claims are directed to heat transfer compositions comprising at least about 50% by weight of HFO-1234yf and a poly alkylene glycol lubricant having an oxypropylene structure and a specific viscosity range. This combination is not suggested by the combinations of prior art cited by the Examiner.

With respect to the Examiner's first ground of rejection, the Examiner has relied on a combination of U.S. Patent 4,945,119 – Smits as the primary reference and U.S. Patent 5,679,875 – Aoyama as the secondary reference. U.S. Patent 5,674,451 - Nimitz is cited by the Examiner as a tertiary reference.

The Examiner relied on Smits for its teaching of blowing agent compositions. Although applicants do not accede to the Examiner's statements about the teachings of Smits with regard to blowing agents, the pending claims are all directed to heat transfer compositions. Since Smits contains no teaching with respect to heat transfer compositions, for this reason alone the Smits patent fails to teach or suggest the subject matter being claimed. Additionally, however, as stated by the Examiner in the outstanding office action, "Smits is further silent as to all the isomers of the propylenes..." (Office Action, paragraph 7). Since the

claims are directed to a fluorinated propylene isomer, specifically, HFO-1234yf, for this additional reason the rejections based on Smits as a primary reference are not viable.

Applicants also specifically traverse the Examiner's reliance on Aoyama on the grounds that "Aoyama et al. teach the utility of this fluorinated propene as a component of effective refrigeration, blowing and cleaning agents." (Office Action, paragraph 7). Applicants respectfully submit that a careful reading of Aoyama et al. reveals that it contains no such teaching. Rather, Aoyama et al. teach only two uses for fluorinated propenes, that is, "as an **intermediate** for compounds that can be substitutes for CFC and HCFC as refrigerants, blowing agents and cleaning agents, and as a **monomer** of macromolecule compounds..." (col. 1, lines 12 – 16) (emphasis added) (see also col. 7, lines 41 – 45). Thus, while Aoyama teaches fluorinated propene as an intermediate useful in making a refrigerant, namely, fluorinated propane, it contains no teaching or suggestion to use the fluorinated propene as a refrigerant.

Nothing in Nimitz overcomes the deficiencies in Smits and Aoyama et al. mentioned above, and therefore the rejection based on this combination is moot, and applicants respectfully request that it be withdrawn.

With respect to the Examiner's second ground of rejection, the Examiner has relied on JP04110388 – Daikin as prima facie evidence of obviousness. Applicants also respectfully submit that a prima facie case of obviousness of the pending claims is not properly made on the basis of Daikin. Applicants note that the claims define a heat transfer composition comprising at least about 50% by

weight of HFO-1234yf and at least one poly alkylene glycol lubricant having particular structural and viscosity limitations. Daikin provides no information regarding the type of lubricant to be used, much less with respect to the specific limitations contained in the claims now pending. Therefore, applicants respectfully submit that a prima facie case of obviousness can not be made on the basis of Daikin alone, or in combination with any of the cited references.

D. Patentability is Established by the Submitted Evidence

Even if it were possible to establish a prima facie case of obviousness based on the prior art cited by the Examiner, applicants respectfully submit that the evidence provided by the attached Declaration of Singh filed concurrently herewith would effectively rebut any such prima facie showing. More particularly, the evidence establishes the following two points:

1 – that the prior art, as a whole, teaches away from the claimed invention; and

2 – that the claimed compositions constitute a selection invention having properties that are unexpectedly superior to the properties of many of the possible compositions within the broad disclosure of Daikin.

Each of these points is explained in detail below.

1 – The Prior Art Teaches Away from The Use of Fluorinated Olefins in Air Conditioning Systems

As established by the attached Declaration of Singh, the Daikin reference discloses generally the use of fluorinated propenes as refrigerants. (see Singh

Declaration (hereinafter "Singh Dec."), paragraph 2). Since Daikin teaches the use of fluorinated propenes having a degree of fluorination ranging from mono-fluorinated to penta-fluorinated, thirty possible compounds (including geometric and stereo isomers) are encompassed within the general teachings of Daikin. *Id.*

In addition, as explained in the Singh Dec. at paragraph 3, Daikin exemplifies the following five fluorinated propenes:

$\text{CF}_3\text{-CH=CH}_2$ (3,3,3-trifluoro-1-propene (HFO-1243zf - see Example 1))

$\text{CF}_3\text{-CH=CFH}$ (1,3,3,3-tetrafluoro-1-propene (HFO-1234ze – see Example 2))

$\text{CH}_3\text{-CF=CF}_2$ (1,2,2-trifluoro-1-propene (HFO-1243yc - see Example 3))¹

$\text{CH}_3\text{-CF=CH}_2$ (2-monofluoropro-1-propene (HFO-1261y) applicants – see Example 4))

$\text{F}_3\text{C-CF=H}_2$ (2,3,3,3-tetrafluoro-1-propene (HFO-1234yf – see Example 5)).

Importantly, Daikin makes no distinction among these molecules and indicates no preference for selection of any one of these molecules over any other molecule within the broad genus of fluorinated propenes.

The invention as now claimed is directed to air conditioning systems. Daikin provides no guidance or suggestion that any one of the molecules within the broad disclosure is preferred for use in air conditioning systems. Furthermore, the prior art generally teaches away from the use of fluorinated olefins for air conditioning systems because of toxicity problems. As is apparent

¹ Applicants note that Daikin erroneously identifies this molecule as 1,2,2-trifluoro-1-propene. The correct designation is 1,1,2-trifluoro-1-propene

to those skilled in the art, the toxicity of a potential refrigerant is an important feature for such material in air conditioning systems because of the potential of the molecule to leak into the air space being conditioned (eg., the passenger compartment of an automobile). The prior art, as a whole, would lead a person skilled in the art away from fluorinated propenes in such systems because of the known toxicity of certain fluorinated propenes, as described below.

As previously submitted to the Examiner, a U.S. Department of Commerce, National Technical Information Service publication, entitled "Support: Letter from Dupont Haskell Lab to US EPA Regarding Results of Bacterial Reverse Mutation Assay Conducted with 1-Propene, 1,1,3,3,3-Pentafluoro-, dated 04/17/00" (Exhibit "A") evaluated the toxicity of a pentafluoropropene compound within the general teaching of the Daikin reference. These tests were conducted by standard methods known to those skilled in the art. In particular, the methods involve determining the LC_{50} or median lethal concentration required to kill half the members of a tested population. The protocol used for this LC_{50} study consisted of a series of separate 4-hour exposures of groups of rats to 1,1,3,3,3-pentafluoro-1-propene (HFO-1225zc). The animals were observed for mortality that may occur during the exposure or within the 14 day post-exposure observation period. Results of this test, which are reported in Table 1 below, illustrate that HFO-1225zc has a toxicity that makes it unacceptable for use as the primary refrigerant molecule in commercial air conditioning applications. (See Singh Dec., paragraph 15).

Table 1

Parameter	HFO 1225zc
Concentration (ppm)	2,000
Initial Population Size (rats)	10
Population Deaths during Exposure	0
Population Deaths after Exposure	6
Population Survival	4
LC ₅₀ (ppm)	Less than 2,000*

*At 2000 ppm, more than half (6/10) of the rats died.

The prior art, as a whole, therefore, teaches away from and would dissuade those skilled in the art from using compounds of the class disclosed in Daikin in air conditioning systems.

The teaching away conclusion is in fact supported by the Examiner's statement in the last office action that "Daikin et al. teach similar compositions prepared from similar compounds which do not damage the ozone layer. One of ordinary skill in the art would expect similar compositions to possess similar properties." Based on this statement, one skilled in the art would expect compounds similar to HFO-1225zc to have toxicity problems.

2 – The Claimed Compositions Exhibit Unexpected Results

The compositions of the present claims exhibit unexpected results in two aspects. The first aspect relates to the unexpectedly low toxicity of the

refrigerant component used in the present compositions. The second aspect relates to the surprisingly superior stability of the refrigerant/lubricant combination which is required by the present claims. Each of these two aspects is discussed in detail below.

A – The Unexpectedly Low Toxicity of the Claimed Refrigerant

The heat transfer compositions as defined by the pending claims are based on the use of HFO-1234yf (2,3,3,3-tetrafluoropropene) in combination with PAG lubricants having a particular structure and having a viscosity within a particular range. The previously presented Declaration of Rusch establishes that the refrigerant now claimed, namely HFO-1234yf, exhibits an unexpectedly low level of toxicity. More specifically, applicants have found that HFO-1234yf is far less toxic than HFO-1225zc. In particular, the information presented in the Rusch Declaration evidences that HFO-1234yf has a toxicity, as measured by LC₅₀, at least approximately **200 times less than HFO-1225zc**. There is nothing in the prior art to suggest or indicate that such a difference would exist.

The Singh Dec. establishes not only that this difference is surprising and unpredictable, but also that the level of toxicity renders the composition acceptable for widespread commercial use in applications in which there is potential exposure to humans, such as in automotive air conditioning. (see Singh Dec., paragraph 14). In contrast, the level of toxicity exhibited by a composition having a like concentration of HFO-1225zc would not be commercially viable in such applications. *Id.*

B - Surprisingly Superior Stability

In addition to the unexpected toxicity properties of the heat transfer compositions of the present invention, applicants' compositions exhibit unexpectedly superior stability. As those skilled in the art understand, the commercial success of heat transfer compositions, such as those used in air conditioning systems, depends to a large extent on the stability of the refrigerant/lubricant combination used. More particularly, it is known and understood by those skilled in the art that deleterious effects on performance can result if the refrigerant changes or reacts in the presence of the lubricant under the conditions of operation. The amount of change or reaction is a measure of the stability or instability of the refrigerant/lubricant combination. Common measures of stability include the amount of free fluoride produced ("Fluoride"), the amount of acid produced ("Total Acid Number" or "TAN"), and whether dimers are produced ("Dimers") when the refrigerant compound and the lubricant are in contact under certain conditions, as explained in more detail below.

An important feature of the present heat transfer compositions is the unexpectedly superior stability of the claimed refrigerant/lubricant combination. The claimed refrigerant/lubricant combination comprises HFO-1234yf and a specific PAG lubricant "in the form of a homopolymer or co-polymer consisting of 2 or more oxypropylene groups and having a viscosity of from about 10 to about 200 centistokes at about 37°C." These limitations on the lubricant are significant because of the commercial importance of such lubricants. More specifically, the

vast majority of the lubricants used by original equipment manufacturers ("OEMs") in automotive air conditioning systems are PAGs consisting essentially of 2 or more oxypropylene groups and having a viscosity of from about 10 to about 200 centistokes at about 37°C. (see Singh Dec., paragraphs 6 and 8)

Thus, a factor contributing to the commercial success of a refrigerant will be the ability of the refrigerant molecule to exhibit a high degree of stability when used in combination with such a PAG lubricant. *Id.*

The lubricant sold by Idemitsu under the designation ND-8 is one of the most widely used lubricants by OEMs for automotive air conditioning systems. ND-8 is a PAG lubricant falling within the lubricant requirements of the present claims, as illustrated by Table 2 below (see Singh Dec., paragraphs 6 and 7):

TABLE 2 – ND-8 PROPERTIES

Property	Viscosity, @ 40°C, cSt	EO:PO Ratio	Molecular Weight
From Testing by Applicant	42.2	0:1	1058*
As Reported in US Patent 7,303,693	42.3	0:1	930

* Number Average Molecular Weight

Specifically, ND-8 is a PAG lubricant having a structure and a viscosity within the lubricant requirements of the present claims (see Singh Dec., paragraphs 5 and 8). More particularly, the EO:PO ratio of 0:1 indicates that ND-8 is formed of only oxypropylene units and the viscosity of 42.2 is within the viscosity requirements of about 10 to about 200 centistokes at about 37°C, as required by the present claims. *Id.*

Applicants have tested ND-8 in combination with the claimed refrigerant HFO-1234yf to demonstrate the unexpectedly superior performance of this combination. The combination of ND-8 and HFO-1234yf, which is a combination within the scope of the present claims, was tested against the combination of ND-8 and three (3) other fluorinated propenes structurally similar to HFO-1234yf. The result of this testing shows, surprisingly and unexpectedly, that the claimed HFO-1234yf/PAG lubricant combination exhibits dramatically superior stability.²

TABLE 3

	Fluoride	TAN	Dimers
HFO-1243zf	2.8	1.6	Yes
HFO-1234yf	75	2.55	No
HFO-1225yez	216	2.2	No
HFO-1234ze	2166	5	No
HFO- 1261yf	160,000	85	Not possible to measure

As explained in the Singh Dec. (see paragraphs 9 – 12), these results establish that the combination of HFO-1234yf with ND-8 is dramatically superior to the combination of that same PAG and all three of HFO-1225yez, HFO-1234ze, and HFO-1261yf. This is evident from the fluoride levels produced in accordance with the stated test procedures. More particularly, the claimed compositions produce a fluoride result that is nearly **three times lower** than that

² The undersigned notes that the data presented for comparison purposes in Table 3 is not even fairly suggested by the prior art since the comparative combinations are not even disclosed in Daikin or suggested by any combination of prior art references. In this regard, applicants are potentially comparing their invention as claimed to compositions that are even closer than the closest item of prior art. Even in such a test the present compositions are shown to have unexpectedly superior performance.

produced by HFO-1225yez, **nearly 30 times lower** than that produced by HFO-1234ze, and **more than 2000 times** lower than that produced by HFO-1261yf. This result is not only dramatically superior, it is completely unexpected. *Id.* In addition, the TAN value for HFO-1234yf is also unexpectedly superior to HFO-1234ze and HFO-1261yf. *Id.*

The absence of dimer production in the present combination is another feature that makes it highly desirable from a stability standpoint relative to the combination based on HFO-1243zf. More particularly, the presence of dimers as exhibited by the HFO-1243zf/ND-8 combination -indicates that dimerization of that fluorinated olefin in the presence of the lubricant has occurred. This establishes that this combination is not stable (see Singh Dec., paragraph 12). Furthermore, the presence of dimers indicates that the combination is much more likely to produce materials that have a deleterious effect on the operation of an air conditioning system. *Id.* In stark contrast, as can be seen by the results reported in the "Dimers" column of Table 2, there was a substantial absence of dimers produced in the ND-8/HFO-1234yf combination. *Id.* This difference is surprising and unexpected.

The above evidence is more than sufficient to rebut any prima facie case of obviousness that might be made.

V. CONCLUSION

The present application is considered to be in condition for allowance, and an early notice thereof is earnestly solicited.

Should the Examiner have any questions concerning this communication, she is respectfully invited to contact the undersigned at her convenience by telephone.

Respectfully submitted,

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